Analytical Chemistry-1

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XE251**	**SEMESTER**	**2nd**
COURSE TITLE	ANALYTICAL CHEMISTRY 1		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	10
Seminars	1	
Laboratory work	4	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Analytical Chemistry).
PREREQUISITE COURSES:	Typically, there are not prerequisite courses. The students should have at least knowledge of the basic concepts of Chemistry.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://www.chem.upatras.gr

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

1. Define basic concepts such as solutions and their characteristics, expressions of the concentration of solutions (molarity, wt. %, etc), precipitates and related terms (precipitation, coagulation, digestion and peptization of colloids, contamination, occlusion and mechanical entrapment, etc) and other concepts of analytical chemistry.
2. Describe and compare the advantages of the various methods of Chemical Analysis.
3. Describe modern analytical techniques that can find applications in a variety of samples (biological, environmental, food, pharmaceuticals, materials and artwork).
4. Perform equilibrium calculations for weak acid and weak base solutions.
5. Choose appropriate pH-indicators and carry out relevant calculations of pH.

6. Perform calculations for the preparation of buffer solutions.
7. Describe the importance of solubility product for the selective precipitation of compounds and the separation of ions.
8. Derive equations and perform calculations in equilibria involving sparingly soluble salts and fractional precipitation.
9. Derive equations and perform calculations in equilibria involving complex formation.
10. Derive equations to describe equilibria in oxidation-reduction systems. Galvanic cells. Electrochemical potentials. Applications of potentials in chemical analysis.
11. Extraction.
12. Chromatography.
13. Describe the methodology for a correct chemical analysis (best practice).
14. Describe fundamental laboratory techniques as well as their advantages and their limitations, e.g. solid–liquid separations methods.
15. Choose the pathways for the separation and identification of chemical substances, combining analytical methods to resolve complex problems.
16. Be able to combine and apply the knowledge acquired in other fields of Chemistry (e.g. Organic Chemistry, Biochemistry etc) in which certain notions and principles of the course in question are necessary and useful and vice-versa.
17. Describe all the safety rules to be applied in a chemical laboratory and recognize what one must not do.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*Others*
Production of new research ideas	

By the end of this course the student will have developed the following skills/competences:

1. Find his/her way in a book of General and Analytical Chemistry to be used as a source of information (e.g. equilibrium constants).
2. Solve problems related to chemical analysis.
3. Use and convert easily the measurement units of various physical quantities and constants
4. Choose the appropriate analytical method for the separation, identification and quantitative analysis of specific substances.
5. Identify and name glassware and apparatus in a chemical laboratory.
6. Organize his/her work in the lab, select the appropriate glassware, perform calculations and prepare standard solutions, etc.
7. Be familiar with the laboratory apparatus and common techniques and their uses, e.g. filtration, centrifugation, extraction, etc.
8. Keep a laboratory notebook.
9. Be able to cooperate in a chemical lab (work in a group).
10. Work following all the standard safety rules for a chemical lab.
11. Be able to adapt to the continuously evolving Analytical Laboratory.

3. SYLLABUS

1. Importance of Analytical Chemistry for Science and everyday life.
2. Methods of chemical analysis.
3. Solutions (water as a solvent, expressions of concentration and conversion between units, principle of mass/matter conservation, principle of electrical neutrality, etc.)
4. Chemical equilibrium of weak acids and bases.
5. Hydrolysis.
6. Formation and dissolution of precipitates. Fractional and homogeneous precipitation.
7. Equilibrium in solutions of complexes.
8. Chemical equilibrium of a redox system.
9. Extraction.
10. Chromatography.
11. Exercises and solutions to problems in the above chapters.
12. Basic chemical laboratory techniques and apparatus (sampling,weighting, volume measurement, precipitation, centrifugation, filtration etc). Theory and practice in an analytical lab.

Laboratory exercises:

1. Separation and identification of cations and anions in solutions (groups I–IV).
2. Qualitative analysis of an unknown solid substance.
3. Chromatography: paper, thin layer, ion exchange.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	1. Lectures using power-point presentations. The students are asked to find information in their documents. Educational software and use of the Internet facilities for information retrieval from data bases and other sources. 2. Tutorials focused on problem solving and exercises of various types: multiple choice, right/wrong, filling the gaps, balancing chemical equations. 3. Laboratory exercises: analysis of solutions of ions or organic substances. Analysis of solid samples.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (PowerPoint) in Lectures.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures (3 contact hours per week x 13 weeks)	39
Seminars (1 contact hour per week x 13 weeks) - solving of representative problems	13
Laboratory exercises (4 contact hours per week x 12 weeks)	48
Final written examination (3 contact hours)	3
Final written examination of the lab (1 contact hour)	1
Private study time of the student and preparation for the half-term evaluations and final examination	146
Course total	***250***

STUDENT PERFORMANCE EVALUATION	1. Evaluation of the result of analysis of unknown solutions.

Description of the evaluation procedure *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	2. Written tests during the laboratory practice through the whole semester. Questions on the theory and problem solving of the same type with those practiced in the tutorials. In order to consider that the student has succeeded in the laboratory practice, the mean value of the marks obtained for the results of the analysis of the unknown solutions and the corresponding test must be at least 5 (pass in 0-10 scale). This consists the 50 % of the final mark. 3. Written examination at the end of the semester. The mark obtained will be the 60% of the final mark provided that it is higher than 5. Greek grading scale: 1 to 10. Minimum passing grade: 5.

5. ATTACHED BIBLIOGRAPHY

1. T.P. Hadjiioannou, "Chemical equilibrium and inorganic qualitative semimicroanalysis", D. Mavrommati Edition, 1999.
2. W.R. Robinson, J.D. Odom, H.F. Holtzclaw Jr., "General Chemistry, with Qualitative Analysis", 10th Edition, Houghton Mifflin Company, 1997.
3. Group authorship of the lab, "Laboratory exercises in Analytical Chemistry, Publications of University of Patras, 2015-2016.